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Case report

Novel fixation method of a periprosthetic fracture of the acetabulum using burr holes through the retained cup for locking screw fixation

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ABSTRACT

The incidence of periprosthetic fractures of the acetabulum associated with a total hip arthroplasty is relatively low but may be increasing. Treatment options depend upon the stability of the prosthesis. In this case, we report an unusual fracture pattern where a large portion of posterior column remained osseointegrated to a displaced uncemented acetabular component and removal of the cup would have resulted in massive structural bone loss and potential pelvic discontinuity. A metal cutting burr was used to create additional screw holes in the cup to allow us to retain the original implant and also obtain fixation of the fracture. The patient had a good outcome at one year with a healed fracture, stable implant, and excellent function. To our knowledge, this technique has not been previously described and offers surgeons an approach to fix these challenging fractures.

Introduction

Traumatic periprosthetic fractures of the acetabulum are uncommon injuries. Only a handful of case reports exist in the literature [1–5]. Treatment of the fracture depends upon the complexity of the fracture and stability of the components [5]. In traumatic fractures, the goals of surgical management include restoration of structural integrity of the columns, restoring bone stock, and obtaining a stable and well-positioned acetabular component. Occasionally, as seen in this case, a fracture through the posterior column may occur, and the acetabular component remains solidly fixed to the displaced column. Open reduction and internal fixation for this fracture pattern has been advocated [5], although fixation of the displaced column may be complicated by compromised bone from stress shielding or osteolysis, and the amount of bone to fix with a plate and screw may be minimal. Attempts to revise the cup in this scenario by removing the osseointegrated posterior column fragment can lead to massive structural bone loss and make subsequent reconstruction exceedingly difficult.

We report a case of a traumatic periprosthetic acetabular fracture treated with a novel technique that combines open reduction internal fixation of the posterior column with adjunctive locking screw fixation through a retained acetabular shell achieved by creating screw holes in the cup with a high speed metal cutting burr and cementing in a liner. The patient gave written informed consent for the publication of this case report.

Case history

A 59-year-old female patient arrived in our Emergency Department after a high-speed motor vehicle accident. The patient was a restrained driver traveling at approximately 60 mph and collided with a tree. She complained of severe pain in the left hip and thigh. Radiographs revealed a displaced left periprosthetic fracture of the acetabulum (Fig. 1). A large segment of the posterior wall remained well-fixed to the cementless implant. The fracture also extended into the anterior column.

The patient's primary hip replacement was performed for osteoarthritis seven years prior to this accident at an outside institution. Notes from this procedure confirmed that the acetabular implant was a Ring Loc titanium two-hole cup manufactured

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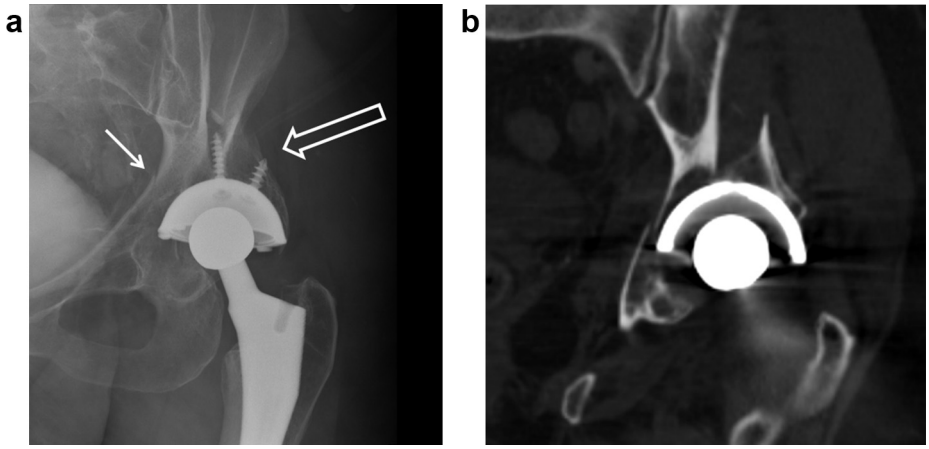

Figure 1. Initial iliac oblique radiograph (a) upon patient arrival demonstrating the comminuted periprosthetic acetabular fracture. The large attached posterior column fragment (open arrow) with associated screws remains well fixed to the displaced cup. Fracture through the anterior column (closed arrow) is also seen. A selected cut from the preoperative CT scan (b) demonstrates the portion of the posterior column that remained well-fixed to the displaced acetabular component.

by Biomet (Biomet, Warsaw, IN). The hip replacement had been functioning well prior to the injury and the patient denied any preexisting pain or functional limitations.

Once the patient had been stabilized from the standpoint of her trauma, operative intervention was undertaken. A posterior approach to the acetabulum was completed and the fracture was exposed. The posterior column fragment was of subjectively poor quality but confirmed to be osseointegrated into the displaced acetabular component. This large posterior bone fragment was reduced and provisionally fixed to the posterior column with Kirschner wires and two reconstruction plates with a limited number of screws (Synthes, West Chester, PA). Attempts to place an anterior column screw were unsuccessful due to the presence of the acetabular component. The modular femoral head was disengaged from the trunnion of the well-fixed femoral stem and the polyethylene liner was removed from the shell with an osteotome. The two previous screws were removed; one longer screw was replaced with good purchase but good fixation could not be obtained through the second hole. A high speed metal cutting burr (Midas Rex, Medtronic, Inc., Minneapolis, MN) was used to create three additional screw holes in the posterosuperior quadrant of the acetabular cup; screws were placed through these holes into both the anterior and posterior columns with good purchase. The four screws afforded excellent stability to the construct. The liner was cemented into the shell after preparing the liner and shell for cementation with the burr. A metal femoral head with appropriate taper was impacted onto the undamaged trunnion and the hip was reduced. The Kirschner wires were removed and final fixation of the plate and screw construct was completed in standard fashion (Fig. 2). The wound was closed in layers over a drain.

Postoperative management consisted of touch down weight bearing for 6 weeks following by 50% partial weight bearing for 6 additional weeks. Full weight bearing with a cane was permitted at 3 months after surgery. Her recovery was otherwise uncomplicated. Follow-up at one year postoperatively revealed a healed fracture and a stable acetabular component (Fig. 3). She was ambulating unassisted without a limp. Her Harris Hip Score was 96.

Figure 2. Intraoperative radiograph demonstrating fracture reduction and supplemental screw fixation through burr holes in the retained acetabular shell.

Discussion

Displaced traumatic fractures of the posterior column of the acetabulum are commonly treated with open reduction internal fixation using plate reconstruction. This approach has been applied to periprosthetic acetabular fractures where a total hip arthroplasty acetabular component remains solidly attached to the host acetabulum [5]. However, the presence of the acetabular component can result in diminished bone stock for fixation, reduced bone quality from osteolysis and/or stress shielding, and compromise anterior column fixation. By using a metal cutting burr to create screw holes in the retained acetabular shell, we were able to improve our fixation of the fracture and the cup to the intact pelvis. This approach allowed us to intervene acutely and allow the patient to mobilize, avoiding potential complications of delaying treatment to allow the fracture to heal prior to attempting reconstruction. It also allow use to retain the shell and associated posterior column bone in a situation where implant removal would have resulted in massive structural bone loss and pelvic discontinuity. This technique does result in the generation of a small amount of titanium

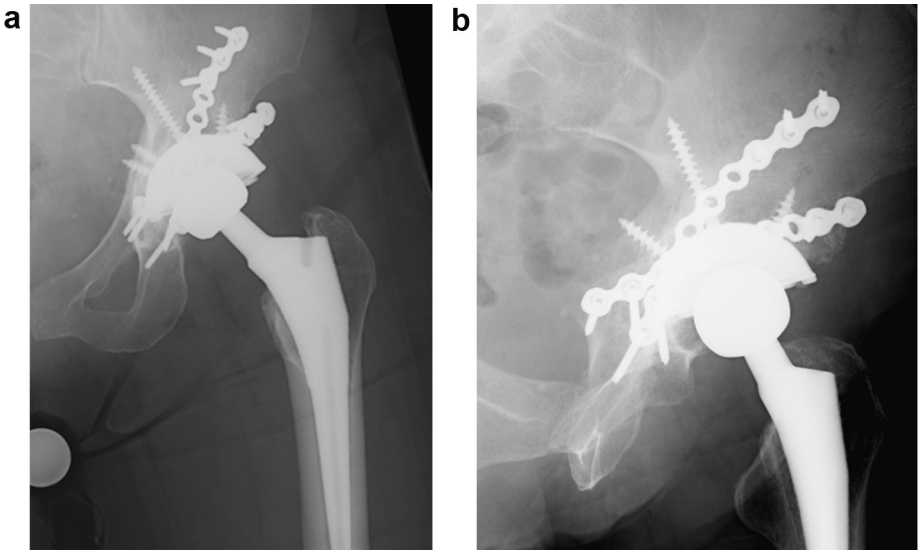

Figure 3. AP pelvis radiograph (a) and iliac oblique view (b) at one year postoperatively demonstrating a healed fracture.

debris, and while we think an inflammatory response to macroscopic titanium debris is unlikely, we cannot eliminate the possibility that a local soft tissue reaction could occur.

An important aspect of this technique is the use of a cemented liner. This was done to accommodate the protrusion of the screw heads into the cup and provide additional angular stability to the screws, in effect creating a locking screw construct. The outer diameter of the liner was downsized by 2 mm to allow for this technique. The backside of the liner and shell were also scored to a 1-mm depth in a spiderweb pattern prior to cementation. This technique to cement an acetabular liner into a cementless shell has been well described by Callaghan et al [6] and we would refer readers to this article for an in-depth discussion of this technique. A biomechanical analysis of cemented liners demonstrated that the cement mantle affords a locking effect on the screws that may increase the initial stability of the construct [7]. Cemented liners have also been shown to be equivalent to standard locking mechanisms in terms of load to failure and lever-out strength [8].

Summary

In this case, we report an unusual fracture pattern where a large portion of posterior column remained osseointegrated to a displaced uncemented acetabular component. A metal cutting burr was used to create additional screw holes in the cup to obtain fixation of the fracture. In our literature review, this technique for fixation of a traumatic periprosthetic fracture of the acetabulum has not been previously described. This approach avoided massive bone loss and provided a successful outcome in this patient. We believe this burr hole locking screw technique is a good option that allows for cup retention and enhanced fixation in patients with similar periprosthetic acetabular fractures.

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